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The Utilization Of Laryngeal Mask Airways Vs. Endotracheal Tubes In Pediatrics With Upper Respiratory Tract Infection In Reducing Airway Complications

Ruby Foster

University of New England

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The Utilization of Laryngeal Mask Airways vs. Endotracheal Tubes in Pediatrics with Upper
Respiratory Tract Infection in Reducing Airway Complications

Ruby Foster, RN, CCRN, SRNA

Advisor: Cheryl Nimmo, DNP, MSHSA, CRNA

University of New England

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Abstract

According to Tait & Malviya, (2005) children typically experience six to eight upper respiratory infections (URIs) per year with ninety-five percent being viral in etiology (Tait & Malvia, 2005). URIs commonly occur in the pediatric population (Bernando-Ocampo, 2012). An issue surrounding the debate on whether a child with upper respiratory infection (URI) should proceed with surgery or cancel surgery is a debate that has been ongoing for several years (Tait et al. 2005). This review examines whether children who have an URI scheduled for surgery are at an increased risk for adverse respiratory complications when the laryngeal mask airway (LMA) is used in comparison to the endotracheal tube (ETT). To date there are limited large scale randomized controlled trials performed on this subject matter. Analyses of the randomized controlled trials performed on this topic have resulted in the use of the laryngeal mask airway reducing respiratory complications by largest percentage. According to (Luce et al. 2014, p.1089) “An OR 95% confidence interval of < 1 indicates a reduced incidence in outcomes associated with laryngeal mask airway use. An MD 95% confidence interval of < 0 indicates reduced PACU stay duration associated with laryngeal mask airway use”. The statistical results of this meta-analyses were “expressed as OR [95% confidence interval < 1] or MD [95% confidence interval of -14.25]” (Luce et al. 2014, p. 1090).

Surgical cancellations are performed less frequently in the pediatric patient with a URI who can safely receive anesthesia. In fact cancellations are not favorable to the parents and/or hospital facility due to the emotional and financial impact (SoYeon, 2013). Parents are financially impacted from the cancellation as this causes them to lose money from missing a

day's work. Further financial strain is then ensued when the parent has to reschedule the surgery, which requires taking more time off from work (Mason, 2013). The hospital takes a loss, if cases are cancelled, and the anesthesia provider takes a loss if they work on a fee for service basis.

Literature for this review was obtained from Cochrane Library, Medline Pub Med and EBSCO CINHAL. Search results yielded randomized control trials, experimental studies, meta-analysis, literature reviews, and systematic reviews. Many articles compared the use of the laryngeal mask airway to that of the endotracheal tube in children. All articles comparing each device in children with an upper respiratory infection concluded that the laryngeal mask airway was the best choice for decreasing adverse respiratory events. However, it is imperative that further research be performed to establish the most effective device to utilize under anesthesia for a child with a URI who presents to surgery.

Keywords

“Laryngeal mask airway”, “endotracheal tube”, “upper respiratory infection”, “pediatric” and “airway complications”

Introduction

The utilization of laryngeal mask airways as compared to the endotracheal tube in children who have upper respiratory infections (URIs), presenting for surgery has been a highly controversial issue for many years. The purpose of this study is to define, explain, and identify the signs & symptoms of URIs as well as to determine how URIs impact the anesthesia provider when making a selection of the best airway device for minimizing adverse respiratory complications during surgery in the pediatric patient.

An upper respiratory tract infection (URI) is defined as an infection of the upper respiratory system, which includes the nose, mouth, pharynx, and larynx. URIs are also known as common colds. Most adults experience two to four upper respiratory infections a year while most children experience about six to eight upper respiratory infections per year (Bernando-Ocampo, 2012). A virus of the upper respiratory tract is contagious and can be spread to others by droplet and contact. There are approximately 200 viruses that attribute to cough, nasal congestion, runny nose, sneezing, sore throat, watery eyes, headaches, body aches, fever, fussiness and tiredness as signs and symptoms that present in children (Bernando-Ocampo, 2012).

Diagnosis of the common cold may sometimes be tricky as there are several differential diagnoses for URIs (see appendix I, p. 22). The best approach towards diagnosing an upper respiratory infection in a child is a thorough pre-operative assessment. Each anesthesia provider's assessment should determine whether the child has a mild or severe URI. Mild

infections consist of clear rhinorrhea, clear auscultation of lungs, no fever and playful child as compared to a severe infection which could include fever >38 degrees Celsius, purulent nasal discharge, productive cough and a lethargic or ill appearing child. Diagnostic testing such as chest- x-ray, blood specimens and nasopharyngeal swabs are also available to confirm the diagnosis.

The biggest issues with children who have URIs are airway complications during or after surgery. Airway hyper-reactivity is the means by which there is a release of inflammatory mediators at the site of viral damage that usually presents to the lower respiratory tract. According to the literature, “Viral neuraminidases are thought to inhibit muscarinic receptors and increase the release of acetylcholine leading to bronchoconstriction” (Bernardo-Campo, 2012, p. 2). Literature also shows that airway complications are also known as perioperative respiratory adverse events (PRAE). Airway complications include: bronchospasm, laryngospasm, persistent cough, desaturation, airway obstruction, hypoxemia, atelectasis, secretions, post- extubation stridor, breath holding and pneumonia (Drake-Brockman et al., 2017).

Anesthesia providers must then decide whether or not to proceed with surgery based on the assessment and suitability of the child’s URI symptoms and multiple risk factors (see appendix, II p. 23). Risk factors include past or present URI, prematurity < 37 weeks, fever, history of asthma, second hand smoke in the home, airway surgery, copious secretions, nasal congestion and obstructive sleep apnea (Bernado-Ocampo, 2012). If the anesthesia provider decides to proceed with surgery, he or she must also decide on what type of airway device to use to decrease airway complications.

In the pediatric patient there are several anatomical, biochemical and physiological characteristics that come into play when deciding what type of airway device to use. The narrowest part of the pediatric airway is the cricoid cartilage due to its conical shape in comparison to that of adults. The trachea of a pediatric patient is also very short. An endotracheal tube that fits snugly can cause airway edema. The pediatric airway is much smaller in diameter and therefore at an increased risk for airway obstruction. Another consideration is the type of surgery and the length of surgery. Physiologically, children have smaller lungs and increased oxygen demand. Infants and children have decreased functional residual capacity and a decreased percentage of type 1 muscle fibers in the lungs that makes them more disposed to respiratory depression and precipitous oxygen desaturation (Singh & Frenkel, 2013). Therefore, the nurse anesthetist must consider all pediatric physiological factors, risks, and benefits as well as pros and cons of each airway device prior to deciding which device is safest to utilize.

The ETT is a device that is inserted through the larynx into the trachea to convey gases and vapors to and from the lungs by manual or positive pressure ventilation (Dorsch & Dorsch, 2008). However when endotracheal tubes are used in pediatric patients it increases airway resistance and work of breathing, especially in children who are suffering from an upper respiratory infection. The endotracheal tube does provide a more secured airway, and decreases the likelihood of gastric insufflation. The laryngeal mask airway was introduced in 1983 and gained world- wide acceptance as an alternative to the traditional ETT (Esch et al., 2017). Per Van Esch et al. (2017) the LMA is a less invasive way to provide positive pressure ventilation and protection of the airway during general anesthesia. Advantages of the laryngeal mask airway are the ease of insertion, stability of hemodynamics on induction, decreases in intraocular

pressure, decreased sore throat and improved arterial oxygenation on emergence (Dorsch & Dorsch, 2008). Disadvantages of the LMA include risk for aspiration, decreased sealing pressure, dislodgement, trauma, bronchospasm and laryngospasm (Dorsch & Dorsch, 2008). Evidence based research on the best airway device to use in pediatrics with URIs is important because it proves the safest way to decrease airway complications.

Methods

A literature review search was conducted using Cochrane & MEDLINE Pub-Med databases to identify relevant articles for the use of this literature review. The initial search was conducted in October 2017. Articles comparing the utilization of ETT vs. LMA use in pediatric patients with and without URI and adverse respiratory complications were analyzed for this literature review. Included in the sample size for studies were healthy ASA I and ASA II patients, and patients that underwent surgeries that could be performed with ETT or LMA. Studies including ASA III or ASA IV patients, adults or children who did not have an upper respiratory tract infection, children with severe lower respiratory tract infection and children with co-existing diseases were all excluded from studies and not included in information of this literature review. Four randomized controlled trials were thoroughly analyzed and used to determine the methodology of the current research.

Another measure examined in the randomized control trial was the incidence of perioperative adverse respiratory events (PRAE). Perioperative adverse respiratory events were defined as laryngospasm, bronchospasm, airway obstruction, coughing, desaturation <95% and

postoperative stridor occurring during induction or emergence (Drake-Brockman et al., 2017). Each article was compared to the John Hopkins Nursing Evidence-based Practice Rating Scale (JHNEBP). The grading scale is divided into two categories, strength and quality. In the strength of evidence category the levels are measured 1-5 and in the quality of evidence category the scale is measured A-C (A being high and C being lowest quality evidence).

Literature Review

Several articles were examined thoroughly and used in support of this literature review. Four sentinel randomized control trials, a systematic review and a quasi- experimental study were used and information was extrapolated. To date there is limited research being done on the use of LMAs vs. ETT in children with URIs. There is also limited research on which device will best limit adverse respiratory complications.

In the systematic review studies performed by Van Esch et al. (2017), four different subtypes of LMAs were compared to the ETT. The LMA Classic, LMA Proseal, LMA Supreme, and LMA Flexible were all compared to the ETT and trialed to assess which LMA would decrease the incidence of airway complications as compared to the ETT. Airway complications were listed as ranging from coughing, sore throat, laryngospasm, to dysphagia and dysphonia. Statistically, in the *LMA Classic* group airway complications were 46% lower as compared to the ETT group that had a 53% of airway complications. The *LMA Supreme* group had 19% of airway complications as compared to 42% in the ETT group. The *LMA Proseal* group had 30% of respiratory complications as compared to the ETT group that had 62% of respiratory complications and the LMA Flexible group had 34% of airway complications as compared to the

ETT group with 49%. Lower incidence rates were found in the LMA subtypes overall but the “incidence of sore throat, dysphagia, and dysphonia were significantly less common in the LMA Supreme group” (Van Esch et al., 2017, p. 148). Per Van Esch et al. (2017) there is no clear incidence of postoperative airway complications between the LMA and ETT and further evaluation of a larger high quality randomized controlled trial is necessary.

The study performed by Wakhloo et al. (2006) had a sample size of 40 children in two groups. Group I consisted of 20 children selected for LMA use and Group II included 20 children selected for ETT use. Children with clear rhinorrhea and mild cough only were included in the study (Wakhloo, 2006). Excluded from the study were children suffering from viral rhinitis, fever, presence of lower respiratory tract infection, wheezing and history of parental smoking (Wakhloo, 2006). The study determined the incidence of sixty percent desaturation, laryngospasm and bronchospasm in group II while total incidence was twenty percent in group I. A vast limitation from the Wakhloo study included the small sample size. The study concluded that endotracheal intubation was associated with greater laryngeal stimulation and increased airway complications in children with URI.

A randomized control study performed by Tait et al. (1998) trialed 82 children with upper respiratory tract infections, ages 3 months to 16 years of age who presented for surgery. Patients were split into two groups: 41 patients were selected for the ETT group and 41 patients for the LMA group. It was reported that there was a significant increase of children who experienced bronchospasms in the ETT group as compared to the LMA groups (12.2% vs. 0%, $p < 0.05$) and overall more airway complications associated with children in the ETT group. Arterial desaturation ($SpO_2 < 90\%$) was also increased with 12.5 % higher desaturation in the ETT group

vs. 0%, $p < 0.05$ in the LMA group. To conclude “overall, there were seven episodes of laryngospasm (one patient had two episodes) six of these episodes were described as partial (four in the LMA and two in the ETT group), and one required the use of a muscle relaxant (ETT group)” (Tait et al., 1998 pg. 4). The likelihood of a laryngospasm was more common in the LMA group, however a drawback of this study would include the manipulation of the airway at insufficient depth of anesthesia on the insertion and removal of the LMA.

Per Tait et al. (1998), postoperatively 41.5% of pediatric patients in the ETT group vs. 25% in the LMA group experienced vomiting and there was twice the incidence of sore throat in these groups respectively (25.6% vs. 13.5%). Comparatively, 5% of parents whose children had an LMA compared to 25.6% of parents whose children had an ETT reported worsening of URI symptoms postoperatively (Tait et al., 1998). The LMA was also compared to the facemask (FM) within this study and advantages of the LMA were the continued ease of use, improved oxygen saturation, less hand fatigue and provided better airway protection in a variety of surgical cases (Tait et al. 1998). Although the FM is advantageous in some situations, the disadvantage of the FM are that it increases the likelihood of esophageal reflux and is not appropriate for airway management in all surgical procedures (Tait et al., 1998). Therefore according to Tait et al. (1998) the LMA is more favorable for children with URI.

Tait et al. (2001) studied 1,078 pediatric patients between the ages of 1 month to 18 years of age. Children were assigned to one of three groups: active URI- (407), recent URI- (335) and a control group- (335). A definitive diagnosis of an active URI included a minimum of two URI

symptoms (rhinorrhea, sore throat, sneezing, nasal congestion, malaise, cough and fever >38 degrees Fahrenheit). Reports of airway obstruction and laryngospasm in the active-URI, recent URI and control groups were 11.1%, 11.0% and 8.6% (Tait et al. 2001). Children with active URIs had slightly higher outcomes than children with recent URIs. Results from this study also suggested that children with active URIs had severe coughing compared to those of children who had no upper respiratory infections.

In regards to airway devices, studies show that the ETT is associated with a higher incidence of breath holding, laryngospasm, bronchospasm, severe cough, oxygen desaturation less than 90% ($p < 0.05$) and adverse events in ETT as compared to LMA or facemask (Tait et al., 2001). Please see the table below.

Table 4. Incidence of Adverse Respiratory Events by Airway Device and Time Points in Children with Active URIs [n (%)]

	Breath Holding	Laryngospasm‡	Bronchospasm	Severe Cough	Spo ₂ < 90%	Adverse Event
Airway device						
ETT (n = 185)	74 (40.2)*	10 (5.4)	14 (7.6)	24 (13.0)*	40 (21.9)*†	75 (40.5)*†
LMA (n = 124)	39 (31.7)*	6 (4.8)	5 (4.1)	11 (8.9)	13 (10.7)	30 (24.2)
FM (n = 91)	9 (9.8)	2 (2.2)	3 (3.3)	4 (4.3)	8 (8.7)	15 (16.5)
Time-points						
Induction (n = 407)	10 (2.5)	4 (1.0)	3 (0.7)	5 (1.2)	16 (3.9)	55 (13.5)
ETT placement (n = 185)	4 (2.2)	2 (1.1)	5 (2.7)	4 (2.2)	8 (4.4)	26 (14.1)
LMA placement (n = 118)	2 (1.7)	1 (0.8)	0 (0)	2 (1.7)	1 (0.9)	7 (5.9)
Intraoperative (n = 407)	4 (1.0)	3 (0.7)	8 (2.0)	3 (0.7)	13 (3.2)	33 (8.1)
ETT removal (n = 185)	12 (6.6)	3 (1.6)	4 (2.2)	10 (5.6)	14 (8.2)	45 (24.3)
LMA removal (n = 118)	3 (2.5)	0 (0.0)	1 (0.8)	2 (1.7)	2 (1.9)	13 (11.0)
PACU (n = 407)	17 (4.2)	5 (1.2)	10 (2.5)	18 (4.4)	31 (7.6)	87 (21.4)

* $P < 0.05$ versus FM. † $P < 0.05$ versus LMA. ‡ Laryngospasm requiring positive airway pressure or succinylcholine.

URI = upper respiratory infection; Spo₂ = oxygen saturation measured by pulse oximetry; ETT = endotracheal tube; LMA = laryngeal mask airway; FM = face mask; PACU = postanesthesia care unit.

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Adverse events were shown to occur on both induction and removal of the ETT but 21.4% of adverse events happened in the post anesthesia care unit (Tait et al., 2001). Results of the study from Tait et al. (2001) show that children with an active URI and a recent URI are at increased risk for adverse respiratory events especially if they have increased risk factors including the use

of the endotracheal tube. In addition to the adverse respiratory events, Tait et al. (2001) also describes children undergoing surgical procedures involving the airway such as tonsillectomy, adenoidectomy, direct laryngoscopy and bronchoscopy as having higher incidences of respiratory complications.

Discussion

Upper respiratory infections are mostly viral in nature with rhinovirus, adenovirus, parainfluenza virus, coronavirus and respiratory syncytial virus accounting for most cases (Mossad, 2013). In the pediatric patient who presents for surgery a determination must be made to continue or cancel surgery based on presenting symptoms. The anesthesia provider can start by assessing the child and ruling out the differential diagnoses to determine if symptoms are infectious or non-infectious (see appendix I, p. 22). Children who present with fever, wheezing, purulent nasal drainage, and elevated respiratory rate usually have an infectious URI and should be canceled for surgery as this may lead to severe respiratory complications during or after surgery (LongNecker, 2008). The safety and best interest of the child are always a priority. However the child that presents with mild URI symptoms may be able to proceed for surgery if the benefits outweigh the risk. (see appendix II, p. 23). The literature review determined that children with URIs have a high risk of adverse incidents when using an ETT vs. LMA. It was also determined from the literature review that those with ... “co-existing reactive airways due to URI are at even greater risk for peri-operative respiratory adverse events” (Shemesh, 2016 p. 802). Younger children under the age of 6 months are also at increased risk for perioperative respiratory complications.

Literature review of the four randomized controlled trials were evaluated and discussed. Researched evidence showed that the Tait et al. (1998) study specifically analyzed 83 children ages 3 months to 16 years of age comparing the use of the LMA to ETT in children with an upper respiratory infection. Each child presented for elective surgery, which included: cystoscopy, hypospadias repair, orchidopexy, hernia repair, strabismus correction, and orthopedic procedures (Tait et al., 1998). Results concluded that the use of the laryngeal mask airway provides a better alternative to decreased airway complications than the ETT. Again, as stated above, Tait et al. (1998) showed that statistically there were greater episodes of breath holding, laryngospasm, bronchospasms and major oxygen desaturation in the ETT group ($P < 0.05$). Additionally, the laryngeal mask airways have many advantages compared to that of the ETT. A major limitation of this study included the sample size. A sample size of 82 children with varied age groups does not present sufficient data when exploring this topic. The demographics of the children were also a limitation, in that the children's race, socioeconomic background and health history were not disclosed or discussed and may have influenced the results tremendously.

A similar study performed by Wakhloo et al. (2006) compared the adverse respiratory events of the ETT vs. LMA in pediatric patients with URI. In this study the sample size included a total of 40 children who were divided into two groups. The Wakhloo study observed only children with clear rhinorrhea and a mild cough, otherwise described as allergic URI (Wakhloo et al., 2006). An allergic URI is caused by an allergen. Limitations from this study included the exclusion of children with viral URIs. The children with viral URIs were classified as having a

severe URI that could cause morbidity and mortality and therefore excluded for safety. A meta-analysis study performed by Luce et al. (2014) studied the rate of respiratory complications between the uses of the supraglottic airway device vs. tracheal intubation in children. The meta-analysis was performed on several available controlled studies comparing LMA to ETT. Meta-analysis was performed on 19 studies that included 732 patients using laryngeal mask airway and 766 patients using the endotracheal tube (Luce et al., 2014).

Per Luce et al. (2014), there were multiple limitations to the study, which included the types of surgery as most of the surgical procedures consisted of hernia repair, strabismus, ENT, adenoidtonsillectomy and general cases. The above-mentioned surgeries could be limitations to the study as few airway-involved surgeries were done. Surgeries that involve the pediatric airway may give a better indication of outcomes on the type of airway device used and the adverse respiratory complications that may occur. The depth of anesthesia at the removal of the airway device (deep extubation vs. fully awake) was a limitation and might favor occurrence of laryngospasm. The uses of muscle relaxation and patient age (more respiratory complications happened in younger patients) were all limitations to this study. In conclusion, laryngeal mask airways during pediatric surgery were found to reduce incidence of postoperative desaturation, laryngospasm, cough, and breath holding and in PACU stay duration (by average of 15min), when compared with the ETT (Luce et al., 2014).

Per Shemesh et al. (2016) the ETT is a strong stimulus for a hyper-reactive airway, especially in a child with active or recent URI and it increases adverse respiratory complications and should be avoided. The LMA has been encouraged as the airway device of choice for

children with an URI who present to surgery. According to Dorsch & Dorsch (2008), LMAs provide a useful alternative to tracheal intubation in children with URI and even in children with broncho-pulmonary dysplasia. The LMA can maintain a suitable airway.

Another slightly different randomized controlled trial was performed at the Princess Margaret Hospital for Children in Perth (WA, Australia). This study trial was the first performed to assess the effect of the endotracheal tube versus the laryngeal mask airway on perioperative respiratory adverse events (PRAE) in infants. 181 infants (aged 0-12 months) were randomly assigned to two groups. The first group included the LMA group (n= 85) and the second group included the ETT group (n= 95). Drake- Brockman et al. (2017) states "...this study had an internal/external data monitoring committee consisting of three independent anesthesia academics with extensive expertise in doing large, randomized controlled studies who reviewed the results of the interim analysis"(p. 704). This was the only level I randomized controlled study that expressed in detail the requirements of the local ethics committee.

Within the demographics portion of the study (see appendix III, p. 24) infants who had recently had a URI < 2 weeks were divided into groups, 39% to the LMA group and 31% to the ETT group (Drake-Brockman et al., 2017). Study results showed a significant increase in the rates of PRAE in infants who had received the endotracheal tube rather than the LMA (Drake-Brockman et al., 2017). Please see (appendix IV, p. 25). Limitations of this study included exclusion of patients who received pre-medication with midazolam. Premedication with midazolam may have been a limitation due to effects on PRAE because it may cause relaxation of the airway tissues and lead to obstruction or development of secretions. Displacements of

LMAs were reported as a limitation and might affect the incidence of PRAE within the study.

Drake-Brockman et al. (2017) states “the differences between LMAs and endotracheal tubes for the management of infants undergoing general anesthesia statistically and clinically showed greater rates overall of PRAE found in infants managed with endotracheal tubes than those managed with LMAs” (p.702). Statistically, Drake- Brockman et al. (2017) states the incidence of PRAE was 20% in children of the LMA group compared to 35% of children in the ETT group. The adverse respiratory events were tripled with the use of the endotracheal tube.

Laryngospasm and bronchospasms occurred five times more frequently when the ETT was used (Drake- Brockman et al., 2017).

Viral infections are known to cause airway hyper-reactivity because of changes to the functional residual capacity, diffusion capacity and decreased airway conductance of the respiratory system (Tait et al., 2001). The significant changes that occur with a viral upper respiratory infection make it a greater risk for bronchospasm and laryngospasm in the patient who is intubated with an ETT. In elective surgery, a 4-6 week waiting period is recommended to reduce adverse pulmonary complications (Wakhloo, 2006). To choose between airway devices, anesthesia providers should consider many factors including severe symptoms (mucus secretions, fever, productive cough), history of asthma, parental smoking, prematurity and surgery of the airway (Tait & Malviya, 2005). Most research in which a study was conducted implicated that the LMA is the best airway device to use to decrease airway complications (Seung & Ross, 2010). Selecting the best airway device is crucial. The desired goal of the anesthesia provider is to keep the patient safe and to decrease any incident of perioperative

adverse events.

Recommendations for future study include the need to duplicate research and specify research related age groups. These groups include neonate (0-3 months), infancy (3-12 months) and children (1-6 years of age) to determine whether the LMA vs. ETT in children with URI is effective at reducing respiratory complications. Current research and literature to support more level I studies regarding this topic should be conducted. Lastly, future discretion should be applied on how perioperative adverse respiratory events can be prevented or treated. The administration of an anticholinergic drug such as glycopyrrolate that works on the muscarinic receptors (M_2 and M_3) should be administered prophylactically to prevent respiratory complications in children with URIs (Tait & Malviya, 2005).

Limitations

Within the literature there are multiple limitations that warrant further future research. A limitation of the Tait et al. (1998) and Drake-Brockman et al. (2017) studies include the depth of anesthesia. Further research and statistics should be gathered during induction and emergence in determining whether or not the depth of anesthesia at time of insertion or removal of (LMA or ETT) each device predisposes the pediatric patient to laryngospasm or bronchospasm. Certainly during induction of anesthesia the ETT can be inserted and stimulate the bronchial airways causing a bronchospasm and on emergence accumulated secretions from the LMA can stimulate a laryngospasm episode (Orgliaguet et al., 2012 & Haleem et al., 2015).

Another varying limitation across the studies was the use of neuromuscular blockers for induction of anesthesia. The 2014 metaanalyses by Luce et al. describes how most of the studies that were analyzed were performed with the use of neuromuscular blocking agents for both ETT and LMAs. Providing neuromuscular blockade for insertion of an LMA is not commonly done and could easily be a limitation of a study. The Drake-Brockman et al. (2017) and Tait et al. (1998) studies similarly discuss how the use of neuromuscular blockers were not used and therefore encourage further statistical input on whether the use of neuromuscular blockers increases or decreases respiratory complications in comparing the two devices.

All studies with the exception of the Drake-Brockman et al. (2017) study provided demographic limitations within the comparison of each device (ETT vs. LMA group). Throughout the literature age ranges varied from that of a premature infant to children 16 years of age. For conducting future research, more emphasis should be placed on specific age ranges. For example, the preschool age of 3-7 years with presenting URI symptoms should be studied in greater depth because children within this age range come in contact with more viruses by the touching of contaminated surfaces, hands to mouth contact and sharing germs with other children. Also studies of the subgroups such as gender, weight, health history, type of surgery, URI symptoms, risk factors, etc. should be conducted further. Surgical cases that involve the airway such as tonsillectomy, adenoidectomy and dental extractions should be considered as these cases may have better determination of outcomes in relevance to which device is best to utilize because surgery is performed directly within the airway and may provide a better outcome in the reduction of respiratory complications.

A rather large limitation amongst the literature is the ethics of study. Performing research on human participants such as children must limit harm and increase benefit. There are codes and guidelines a researcher must follow. Researchers performing a randomized control trial will have an ethics committee board that grants approval or disapproval before the research is conducted. Performing research studies on children with URIs does allow for this information and data to be gathered but in some cases it may be unethical to perform research. For example research should most certainly not be conducted on a child who has severe URI symptoms (fever, productive cough, copious secretions, lethargy) or has cardiac anomalies or any other underlying diseases as this may increase morbidity and mortality. According to Drake-Brockman et al. (2017) parental or guardian consent was obtained before enrollment within the study and as previously mentioned an independent data monitoring committee was formed to review data outcomes.

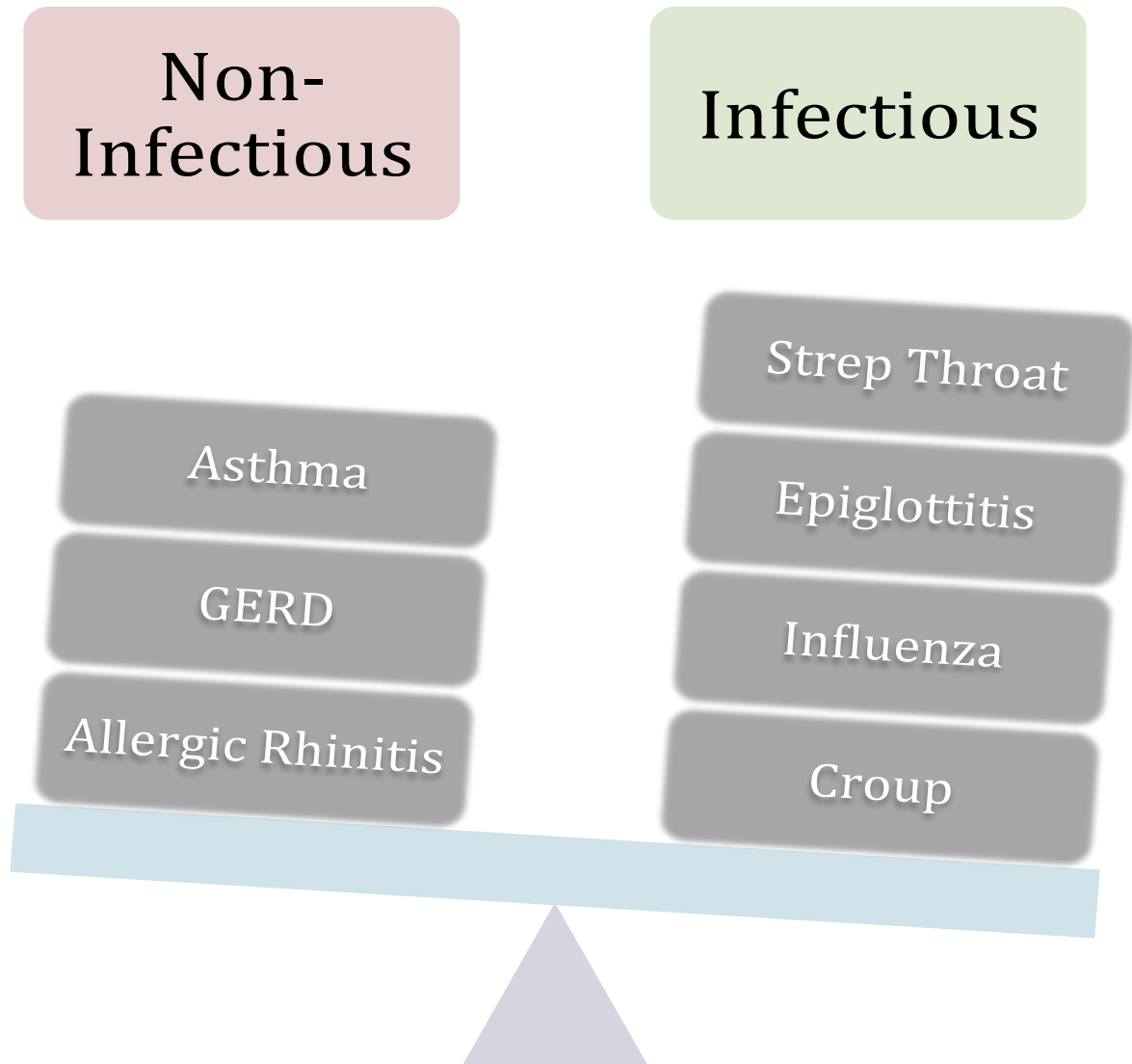
Another weakness is that there was limited mention of whether cuffed or un-cuffed tracheal tubes were used, which may have influenced the incidence of cough or bronchospasm greatly. Uncuffed endotracheal tubes will make it easier for secretions to travel to the bronchial airways and initiate a bronchospasm. The meta-analysis by Luce et al. (2014) describes some studies as inconsistent in the use of the uncuffed ETT while more consistent in other studies with cuffed ETTs therefore making it impossible to guide results. To conclude, due to many weaknesses within the literature, this author's recommendations are to perform stronger level I randomized controlled trials on this topic.

Conclusion

The goals of anesthetic management for a child with URI symptoms presenting for surgery are to minimize secretions and avoid or limit stimulation of a potentially already irritable airway (Bernardo- Ocampo 2012). Bernardo- Ocampo (2012) & Becke (2012) recommend bronchodilators be given 10-30 minutes before surgery in conjunction with inhaled steroids. Anticholinergic drugs such as atropine and glycopyrrolate have also been stated as a form of anesthetic management for the child with URIs, however more research needs to be conducted (Bernardo- Ocampo, 2012). It is important for the anesthesia provider to perform a thorough assessment and determine which risk factors apply. The anesthesia provider should use his/her assessment as well as an analysis of risk factors in guiding an appropriate decision on whether to proceed with surgery. If the decision is made to proceed with surgery an algorithm can be used as a resource to determine the appropriate course for a child who has a URI (see appendix II, p. 23). Again as stated above, the importance of the selection of the best airway device is for safety and the reduction of adverse respiratory outcomes.

From the literature review, conclusive evidence supports the use of ETTs as associated with an increased risk of perioperative respiratory adverse events. Safety is the overall goal of each individual patient. The LMA has proven beneficial in decreasing stimulation, thus decreasing respiratory complications. However, there is further need for level I randomized control studies and testing of airway devices (LMA vs. ETT) in determination of the best airway device to utilize in the pediatric patient with a URI. The approval of an ethics committee and the outline of detailed requirements are needed for the safety of each study. Future research is

helpful for the nurse anesthetist because it will offer the best practice to the pediatric (vulnerable) population. The randomized control tests should be done with bigger sample sizes, specific age related groups and specific ethnicities with emphasis on how all of these inclusions affect the adverse respiratory complications when the laryngeal mask airway is utilized as compared to the endotracheal tube.

Appendix I**Fig 1.1 Differential Diagnosis of URI**

Appendix II

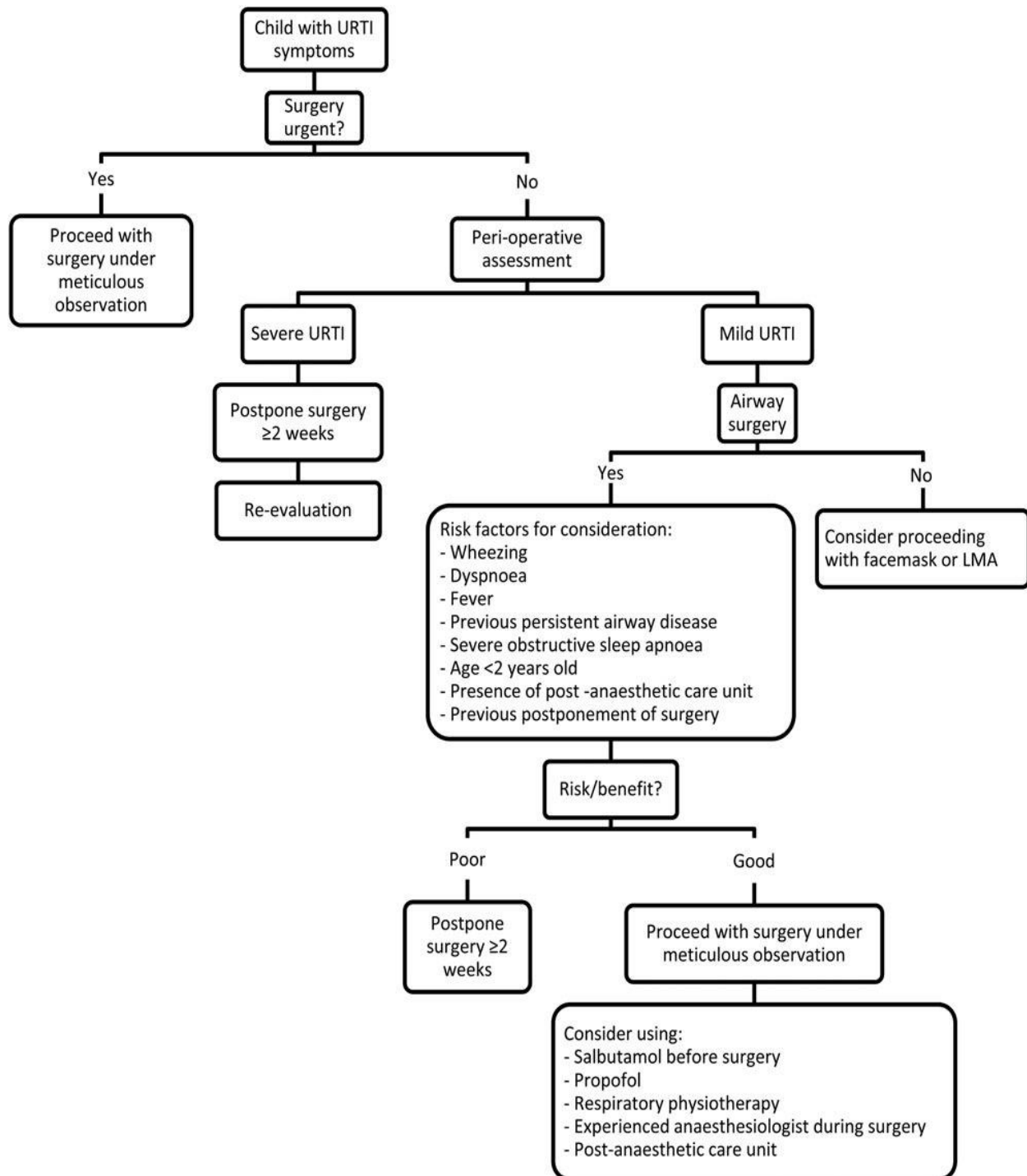


Fig 1.2 Algorithm for management of a child with URI (Shemesh et al. 2016)

Appendix III

	Laryngeal mask airway (n=83)	Endotracheal tube (n=94)	p value
Postnatal age (months)	8.1 (4.5–9.6)	7.1 (2.9–10.5)	0.421
Corrected age (months)	7.9 (4.5–9.4)	7.0 (2.9–10.4)	0.657
Weight (kg)	8.2 (6.8–9.5)	7.9 (6.1–9.6)	0.868
Premature	13 (16%)	8 (9%)	0.159
Male sex	54 (65%)	65 (69%)	0.631
Risk factors			
Respiratory symptoms			
Recent URTI (in past <2 weeks)	32 (39%)	29 (31%)	0.342
Wheeze	2 (2%)	3 (3%)	1.00
Wheeze on exercise	0	0	..
Nocturnal cough	2 (2%)	7 (7%)	0.176
Any	35 (42%)	35 (37%)	0.321
Non-respiratory symptoms			
Current or previous eczema	15 (18%)	13 (14%)	0.537
Family history of asthma	32 (39%)	31 (33%)	0.529
Family history of eczema	20 (24%)	22 (23%)	1.00
Family history of hay fever	41 (49%)	30 (32%)	0.021
Passive smoke exposure	28 (34%)	33 (35%)	0.875
Any	66 (80%)	68 (72%)	0.673
Number of risk factors			
None	11 (13%)	17 (18%)	0.415
1–2	42 (51%)	49 (52%)	0.881
≥3	30 (36%)	28 (30%)	0.423
Procedural specialty			
General	47 (57%)	60 (64%)	0.358
Orthopaedics	11 (13%)	12 (13%)	1.00
Radiology	8 (10%)	7 (7%)	0.788
Plastics	7 (8%)	10 (11%)	0.295
Other	10 (12%)	5 (5%)	0.045

Data are presented as median (IQR) or n (%), unless otherwise stated. URTI=upper respiratory tract infection.

Table 2: Demographics and characteristics of participants

Adapted from “The effect of the endotracheal tubes versus laryngeal mask airways on perioperative respiratory adverse events in infants: a randomized controlled trial. Drake-Brockman, E T., Ramgolam, A., Zhang, G., Hall, G., Ungern-Sternberg, B. (2017) pg 704.

Appendix IV

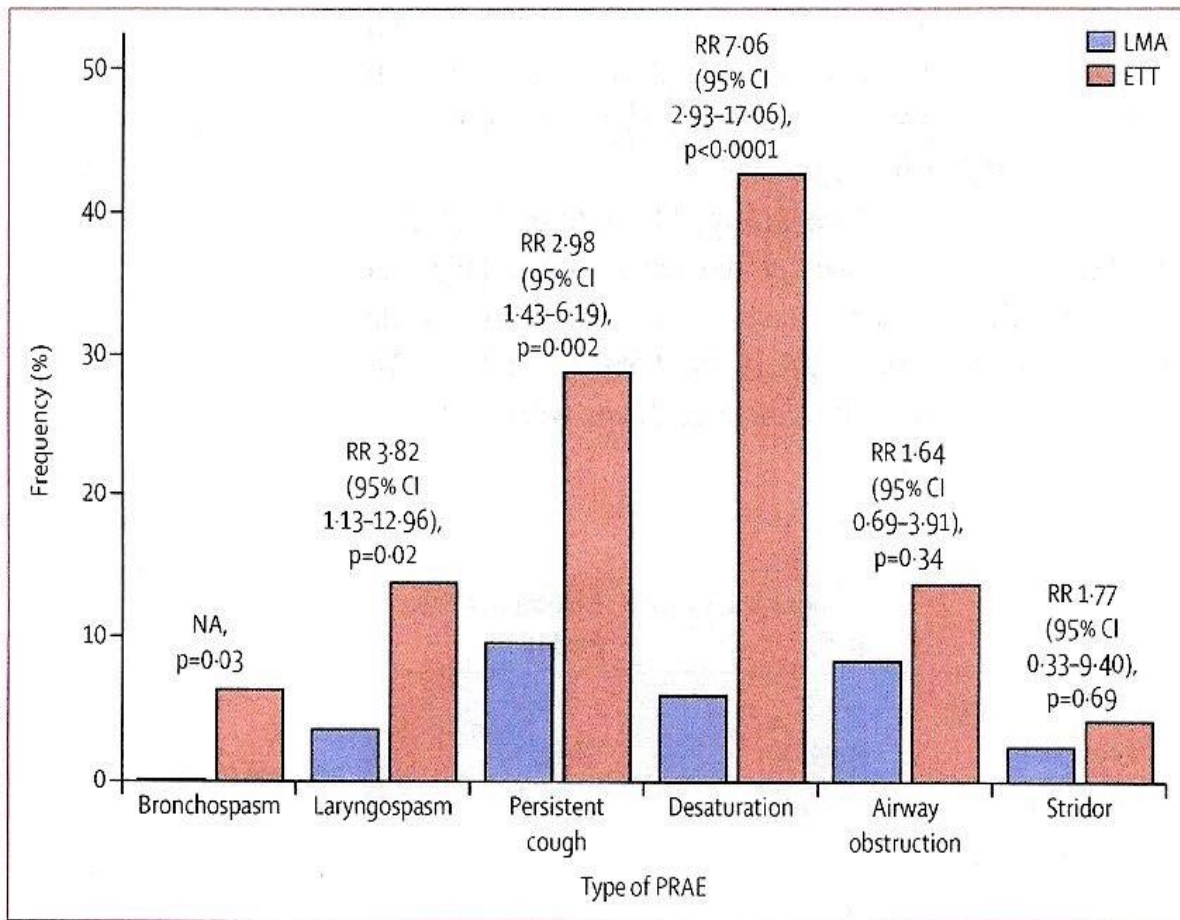


Figure 2: Frequency of PRAE during the perioperative period in infants having minor elective surgery
PRAE=perioperative respiratory adverse events. NA=not applicable. RR=risk ratio. LMA=laryngeal mask airways.
ETT=endotracheal tubes.

Adapted from “The effect of the endotracheal tubes versus laryngeal mask airways on perioperative respiratory adverse events in infants: a randomized controlled trial. Drake-Brockman, E T., Ramgolam, A., Zhang, G., Hall, G., Ungern-Sternberg, B. (2017). Pg. 706

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